भारतीय मानक
Indian Standard

IS 12218 : 2018

स्वचल वाहनों के प्रवेश, प्रस्थान और रैम्प कोणों के मापन की पद्धति

(पहला पुनरीक्षण)

Method of Measurement of Approach, Departure and Ramp Angles of Automotive Vehicles

(First Revision)

ICS 17.040.01;43.020

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Automotive Braking and Steering System, Vehicle Testing and Performance Evaluation Sectional Committee, TED 04

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking and Steering System, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

The overall performance of vehicle is a function of performance of its various components, systems, instrumentation, etc. This standard specifies a uniform method for measurement of the approach, departure and ramp angles.

This standard was first published in 1987 and reaffirmed many times until 2012. In this revision of the standard, following changes have been made:

a) Definitions of approach angle, departure angle and ramp angle included for better clarity.
b) Illustrations to determine approach, departure and ramp angles were corrected with modified illustrations.
c) Requirements for off road vehicles included.

Annex A is given for information.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHOD OF MEASUREMENT OF APPROACH, DEPARTURE AND RAMP ANGLES OF AUTOMOTIVE VEHICLES

(First Revision)

1 SCOPE

This standard specifies the method of measurement of approach, departure and ramp angles for M and N category vehicles as defined in IS 14272.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

IS No.	*Title*
9435 : 2004	Terms and definitions relating to dimensions of road vehicles other than 2 and 3 wheelers (*first revision*)
14272 : 2011	Automotive vehicles — Types — Terminology (*first revision*)

3 DEFINITIONS

The following definitions in addition to those given in IS 9435 shall apply.

3.1 Approach Angle

The greatest angle between the horizontal plane and planes tangential to the static loaded front wheel tyres, such that no point of the vehicle ahead of the front axle lies below these planes and that no part rigidly attached to the vehicle with the exception of any steps, lies below these planes. When measuring the approach angle (*see* Fig. 1), no account is taken of under-run protective devices.

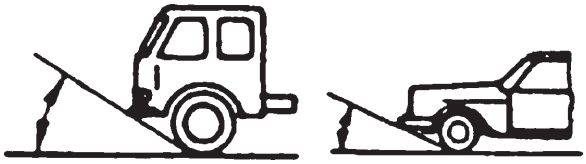


FIG. 1 APPROACH ANGLE

3.2 Departure Angle

The greatest angle between the horizontal plane and planes tangential to the static loaded rear wheel tyres, such that no point of the vehicle behind the axle lies below these planes and that no part rigidly attached to the vehicle, lies below these planes. When measuring the departure angle (*see* Fig. 2), no account is taken of under-run protective devices.

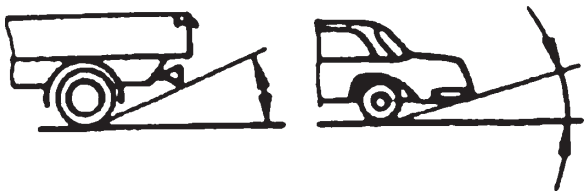


FIG. 2 DEPARTURE ANGLE

3.3 Ramp Angle

The minimum acute angle measured between two planes, perpendicular to the longitudinal median plane of the vehicle, tangential, respectively, to the tyres of the front and the rear wheels, static loaded, and intersecting at a line touching the rigid lower part of the vehicle, outside these wheels. This angle defines the largest ramp over which the vehicle can move. When measuring the ramp angle (*see* Fig. 3), no account is taken of under-run protective devices and exhaust system parts.

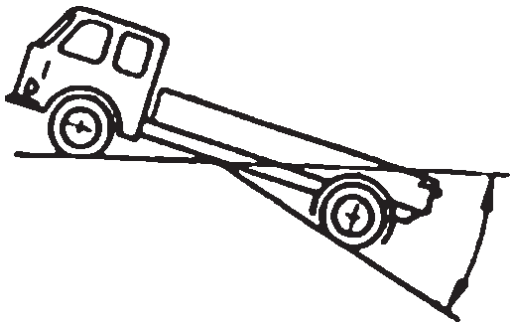


FIG. 3 RAMP ANGLE

4 FEATURES OF TEST TRACK

Test track shall be a plane level and hard ground.

5 PREPARATIONS OF VEHICLES

5.1 The vehicle shall conform in all parts, components and sub-systems to the design and/or production series as applicable.

5.2 The vehicle shall be loaded to the maximum GVW as declared by the manufacturer and load distribution between the axles shall be as per the manufacturer's recommendation.

5.3 The vehicle shall be fitted with tyres, which shall have a tread depth of not less than 90 percent of tread depth on new tyre. The tyres shall be inflated to the pressure recommended by the manufacturer.

5.4 The vehicle shall be parked on the test track in such way that all its wheels are resting on the same horizontal plane. The engine shall be switched off and parking brake applied. The wheels shall be pointing towards the straight ahead condition.

6 MEASUREMENTS

6.1 Approach Angle (α)

The greatest angle between the horizontal plane and planes tangential to the static loaded front wheel tyres (*see* Fig. 4) shall be calculated as follows:

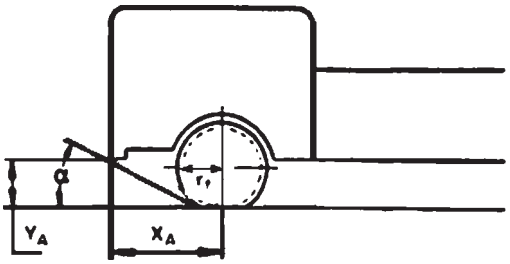


FIG. 4 APPROACH ANGLE

$$\alpha = \sin^{-1} \frac{r_t}{\sqrt{X^2{}_A + (r_t - Y_A)^2}} - \tan^{-1} \frac{r_t - Y_A}{X_A}$$

where

X_A = distance between least favourably point in front of the front axle and centre line of front axle,

Y_A = height of least favourably point from the ground, and

r_f = front tyre radius.

The least favourably placed points which shall not include the number plate may be chosen by visual judgment and in case of doubt, measurements may be done for the various possible points and the smallest angle may be reported.

The approach angle shall be expressed in degrees, rounded off to the nearest half degree. An approach angle not less than 12° recommended.

6.2 Departure Angle (β)

The greatest angle between the horizontal plane and planes tangential to the static loaded rear wheel tyres (*see* Fig. 5) shall be determined as follows:

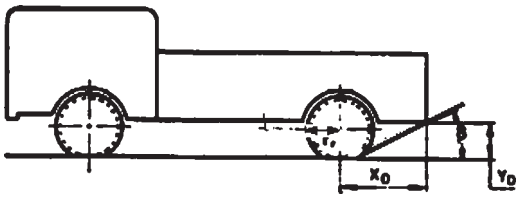


FIG. 5 DEPARTURE ANGLE

$$\beta = \sin^{-1} \frac{r_r}{\sqrt{X^2{}_D + (r_r - Y_D)^2}} - \tan^{-1} \frac{r_r - Y_D}{X_D}$$

where

X_D = distance between least favourably point in rear of the rear axle and centre line of rear axle,

Y_D = height of least favourably point from the ground, and

r_r = rear tyre radius.

The least favourably placed point which shall not include the number plate may be chosen by visual judgment and in case of doubt, measurements may be made for various doubtful points and the smallest angle may be reported.

The departure angle shall be expressed in degrees, rounded off to the nearest half degree. A departure angles not less than 10° is recommended.

6.3 Ramp Angle

The minimum acute angle measured between two planes, perpendicular to the longitudinal median plane of the vehicle, tangential, respectively, to the tyres of the front and the rear wheels, static loaded, and intersecting at a line touching the rigid lower part of the vehicle, outside these wheels shall be determined as follows:

While determining the ramp angle (*see* Fig. 6) for multi axle vehicles, innermost wheels of front or front combination axles and rear or rear combination axles shall be considered.

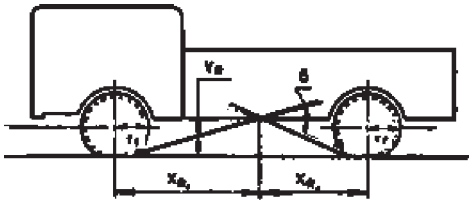


FIG. 6 RAMP ANGLE

$$\delta = \sin^{-1}\frac{r_t}{\sqrt{X^2_{Rf} + (r_t - Y_R)^2}} - \tan^{-1}\frac{r_t - Y_R}{X_{Rt}} + \sin^{-1}\frac{r_r}{\sqrt{X^2_{Rr} + (r_r - Y_R)^2}} - \tan^{-1}\frac{t_r - Y_R}{X_{ar}}$$

where

X_{Rf} = distance between least favourably point between the axles and centre line of front axle,

X_{Rr} = distance between least favourably point between the axles and centre line of rear axle,

Y_R = height of least favourably point between the axles from the ground,

r_r = rear tyre radius, and

r_f = front tyre radius.

The least favourably placed point may be chosen by visual judgment and in case of doubt, measurements may be made for various points and the smallest angle may be reported.

The ramp angle shall be expressed in degrees and rounded off to the nearest half degree. A ramp angles not less than 15° is recommended.

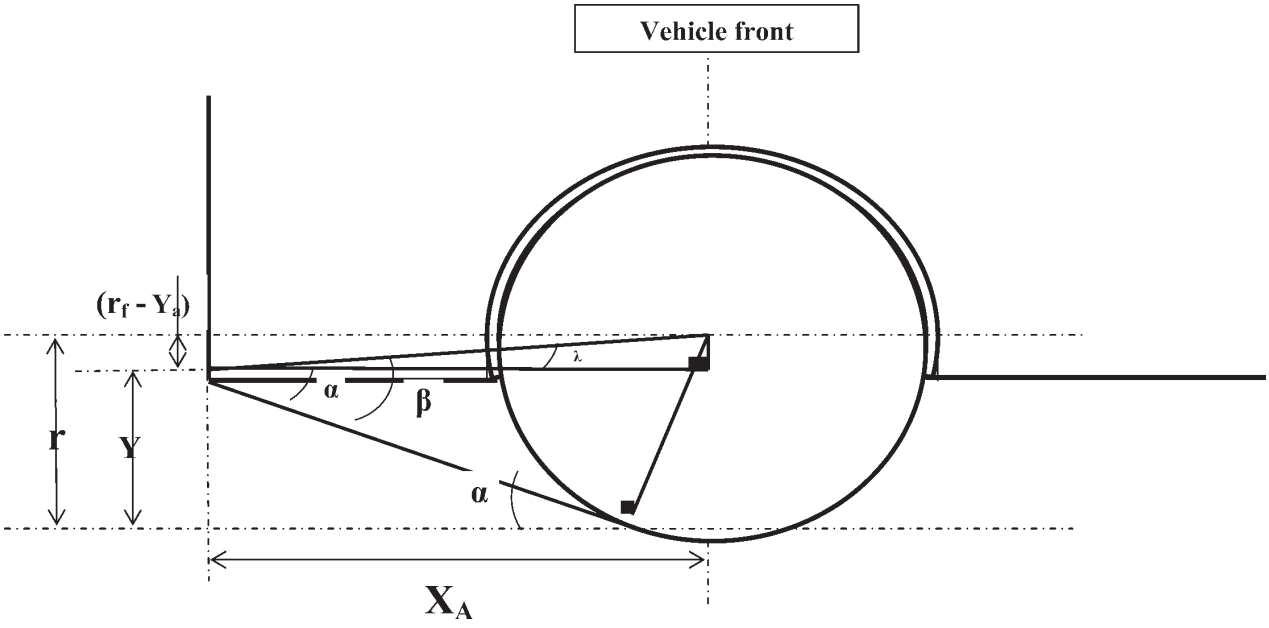
7 OFF ROAD VEHICLES (CROSS COUNTRY VEHICLES)

Approach angle, departure angle and ramp angle requirements for off road vehicles of categories M and N shall meet the requirements of IS 14272.

ANNEX A
(*Informative*)

A-1 MEASUREMENTS OF APPROACH ANGLE (α)

The greatest angle between the horizontal plane and planes tangential to the static loaded front wheel tyres shall be determined as follows:



where

X_A = the distance between least favourably point in front of the front axle and centre line of front axle,

Y_a = the height of least favourably point from the ground, and

r_f = the front tyre radius.

$$\alpha = \beta - \lambda$$

$$\sin\beta = r_f / [X^2_A + (r_f - Y_a)^2]^{0.5}$$

$$\beta = \sin^{-1}\{r_f / [X^2_A + (r_f - Y_a)^2]^{0.5}\}$$

$$\tan\lambda = (r_f - Y_a) / X_A$$

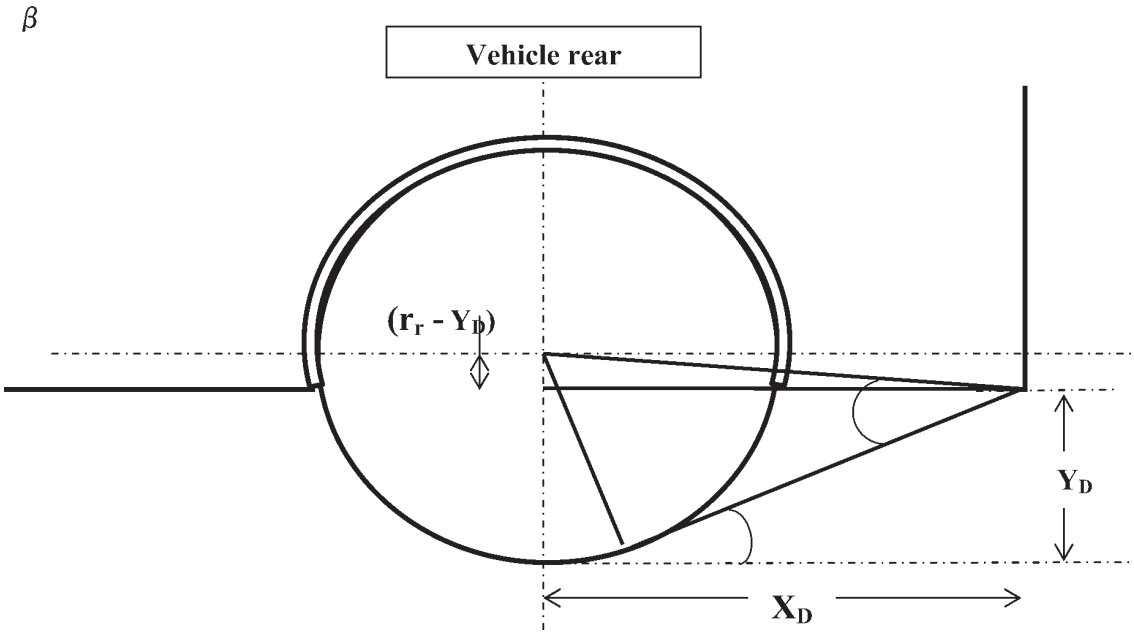
$$\lambda = \tan^{-1}[(r_f - Y_a) / X_A]$$

$$\alpha = \beta - \lambda$$

$$\alpha = \sin^{-1}\frac{r_t}{\sqrt{X^2_A + (r_t - Y_A)^2}} - \tan^{-1}\frac{r_t - Y_A}{X_A}$$

A-2 MEASUREMENT OF DEPARTURE ANGLE (β)

The greatest angle between the horizontal plane and planes tangential to the static loaded rear wheel tyres shall be determined as follows:



X_D = distance between least favourably point in rear of the rear axle and centre line of rear axle,

Y_D = height of least favourably point from the ground, and

r_r = rear tyre radius.

The least favourably placed points which shall not include the number plate may be chosen by visual judgement and in case of doubt, measurements may be done for the various possible points and the smallest angle may be reported.

$$\beta = \alpha - \lambda$$

$$\sin \alpha = \frac{r_r}{\sqrt{X^2{}_D + (r_r - Y_D)^2}}$$

$$\tan \lambda = \frac{r_r - y_D}{X_D}$$

$$\beta = \sin^{-1} \frac{r_r}{\sqrt{X_D^2 + (r_r - y_D)^2}} - \tan^{-1} \left(\frac{r_r - y_D}{X_D} \right)$$

A-3 MEASUREMENT OF RAMP ANGLE (δ)

The minimum acute angle measured between two planes, perpendicular to the longitudinal median plane of the vehicle, tangential, respectively, to the tyres of the front and the rear wheels, static loaded, and intersecting at a line touching the rigid lower part of the vehicle, outside these wheels shall be determined as follows:

X_{Rf} = distance between least favourably point between the axles and centre line of front axle,

X_{Rr} = distance between least favourably point between the axles and centre line of rear axle,

Y_r = height of least favourably point between the axles from the ground,

r_r = rear tyre radius, and

r_f = front tyre radius.

The least favourably placed points which shall not include the number plate may be chosen by visual judgment and in case of doubt, measurements may be done for the various possible points and the smallest angle may be reported.

$$\lambda = \alpha - \beta$$

$$\sin\alpha = \frac{r_f}{\sqrt{X_{Rf}^2 + (r_r - Y_R)^2}}$$

$$\tan\beta = \frac{r_r - y_R}{X_{Rf}}$$

$$\lambda - \sin^{-1}\frac{r_f}{\sqrt{X_{Rf}^2 + (r_f - y_R)^2}} - \tan^{-1}\left(\frac{r_f - y_R}{X_{Rf}}\right)$$

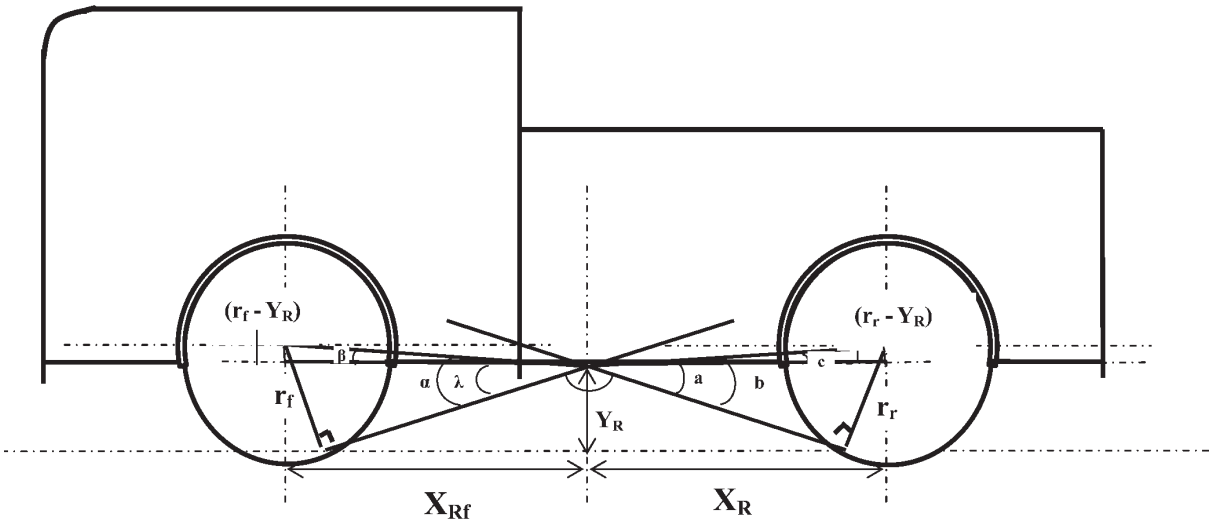
$$a = b - C$$

$$\sin b = \frac{r_r}{\sqrt{X_{Rr}^2 + (r_f - Y_R)^2}} \Rightarrow b = \sin^{-1}\frac{r_r}{\sqrt{X_{Rr}^2 + (r_f - Y_R)^2}}$$

$$\tan c = \frac{r_r - y_R}{X_{Rr}} \Rightarrow c = \tan^{-1}\frac{r_r - y_R}{X_{Rr}}$$

$$a = \sin^{-1}\frac{r_r}{\sqrt{X_{Rr}^2 + (r_r - y_R)^2}} - \tan^{-1}\left(\frac{r_r - y_R}{X_{Rr}}\right)$$

$$\text{Ramp angle} = \lambda + a = \delta = \sin^{-1}\frac{r_f}{\sqrt{X^2_{Rf} + (r_f - Y_R)^2}} - \tan^{-1}\frac{r_f - Y_R}{X_{Rf}} + \sin^{-1}\frac{r_r}{\sqrt{X^2_{Rr} + (r_f - Y_R)^2}} - \tan^{-1}\frac{r_r - Y_R}{X_{Rr}}$$



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Review of Indian Standards

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Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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